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Physico-Chemical Institute Imeni L. Ya. Karpov (GosPlankh)
USSR

Academy of Sciences of the USSR
Institute of Chemistry
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PHYSICO-CHEMICAL INSTITUTE IMINI L. Ya. Karpov (GosFizKhim)

Address: No 10, Ul. Obukha, Moscow.

Telephone: Zh-1-75-20 or Zh-1-75-21.

GosFizKhim is subordinate to the Sector of Scientific Research and Technical Propaganda, People's Commissariat for Heavy Industries.

Director : Academician A. N. Bakh

Deputy Director for Scientific Matters - Academician A. N. Franklin

GosFizKhim conducts scientific research work in the field of physical chemistry: surface phenomena, colloid chemistry, catalysis and chemical kinetics, contemporary theory of the structure of chemical compounds and photo-chemistry.

Scientific Divisions and Laboratories:

Sectors:

Methodology

Divisions:

Surface Phenomena

Colloid Chemistry

Inorganic Chemistry

Theory of the Structure of Matter

Catalysis and Chemical Kinetics

~~Technical~~
~~Engineering~~ Electrochemistry

Combustion of Gases and Thermo-chemistry

Laboratories:

Photochemistry

Aerosols

~~Liquefied~~
~~Combustion of~~ Gases

Complex Compounds

Super-~~Hard~~ ~~Solutions~~ ^{Compounds}Reactions in Dissolved ^{State} ~~Materials~~

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Analytical Chemistry
 Biological Catalysis
 Chemical Kinetics
 Heterogeneous Catalysis
 Organic Catalysis

LEADING SCIENTIFIC PERSONNEL AND SPECIALISTS:

Academician A. N. Bald - Chief, Laboratory of Biological Catalysis. He has been awarded the Order of Labor Red Banner.

Academician A. N. A. - Chief, Division of Surface Phenomena

Prof. P. B. Vyazovoy - Chief, Methodological Sector

Prof. I. A. Kazarnovskiy - Chief, Division of Inorganic Chemistry

Prof. A. M. Monastov - Chief, Division of ^{Liquefied} ~~Combustion of~~ Gases and Thermo-
 Chemistry.

Corresponding Member, Academy of Sciences USSR, Prof. A. I. Rabinovich - Chief, Division of Colloid Chemistry and the Laboratory of Photochemistry.

Prof. Ya. K. Syrkin - Chief, divisions of the Theory of the Structure of ^{that of} ~~the~~ ^{- also of the} ~~the~~ Catalysis and Chemical Kinetics, ~~and~~ ^{the} Laboratory of Chemical Kinetics.

B. P. Bruns - surface phenomena. Awarded the Order of Labor Red Banner for his work as a member of the Arctic Expedition on the "Sibiryakov".

A. A. Vasil'yev - analytical chemistry

Engineer G. A. Dmitriyev - Chief, Laboratory of Reactions in ^{the} ~~the~~ Dispersed ~~State~~ ^{Materials}.

H. Ya. Kagan - Chief, Laboratory of Heterogeneous Catalysis

V. A. Kargin - colloid chemistry

S. S. Medvedev - Chief, Laboratory of Organic Catalysis

Engineer B. F. Ormont - Chief, Laboratory of Complex Compounds

Engineer D. V. Stepanov - Chief, Division of ^{Technical} ~~Engineering~~ Electro-chemistry

M. A. Fuks - Chief, Aerosol Laboratory

E. Ya. Shtuber - Chief, Analytical Chemistry Laboratory.

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EXPERIMENTAL BASIS OF THE INSTITUTE:

Semi-Industrial Station of the Institute

Investigations

Conducts ~~types~~ to determine the industrial suitability of various production methods developed by the Institute on its model equipment. Deputy Chief of the Station is K. I. Khachaturov.

The Station is equipped with the following: milling equipment, drying equipment, Hebler boilers, centrifuges, filter-presses, combination grinders ^{by depressor} and driers (disk type and a ~~type~~ ^{rotary} type), ^{continuous} ~~continuous~~ bath for copper ^{plating of} wire, compressors for compressed air and equipment for producing liquid air.

Leningrad Experimental Installation;

Located at Moskvorechye, on the Kurak Railroad; produces aluminum chloride out of kaolin. Deputy Chief of the Installation is I. A. Kazarnovskiy.

Over-all number of personnel	372
Scientific workers	186
Annual Budget (1935)	2,025,000 rubles

BASIC PROBLEMS CURRENTLY UNDERTAKEN FOR STUDY BY THE INSTITUTE:

Studies of the over-voltage of hydrogen on various metals. Changes of the capacity of the double electric layer. Studies of the nature of electro-capillary phenomena and ⁶wetting. Studies of the nature of electro-kinetic phenomena. Studies of the structure of electrodes manufactured of noble metals. Determination of ~~the~~ ⁶contact potentials on the boundary of metal-vacuum. Chief of research, Academician A. N. Frumkin.

Studies of the mechanism of catalysis in processes characterized by activated adsorption. Chief of research, Academician A. N. Frumkin.

Studies of the electric properties of aerosols. Kinetics of condensation processes. Chief of research, N. A. Fuks.

Electrolysis of lyophobic colloids. Studies of the stability of lyophobic colloids. Studies of the mechanism of reactions in colloidal systems. Study of the structure of ⁶the surfaces of colloidal particles.

Studies of the mechanical, dielectrical and electro-chemical properties of lyophobic colloids. Chief of research, Prof A. I. Rabinovich.

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Use of roentgenological analysis for studying the structure of colloids and crystals.

Studies of the ^{energy} characteristics and mechanism of simple and sensitized photochemical reactions. Studies of adsorption phenomena in photographic processes. Chief of research, Prof. A. I. Fabinovitch.

Studies of the mechanism of oxidation of hydrocarbons in their gaseous and liquid ^{state} ~~phases~~. Studies of the mechanism of thermal and catalytic ~~dis-~~ ^{decomposition} ~~integration~~ of hydrocarbons. Polymerization of ^{unsaturated} ~~saturated~~ hydrocarbons. Chief of research, G. S. Medvedev.

Studies of the adsorption properties of catalysts in the synthesis of ammonia. Kinetics of gas reactions. Chief of research, N. Ya. Kagan.

Kinetics of ^{enzyme} ~~reactions~~, which ^{bind} ~~unite~~ with atmospheric nitrogen at ordinary pressure and temperature. Chief of research, Academician A. M. Bakht.

Kinetics of gaseous heterogeneous catalytic reactions. Studies of the mechanism of contact oxidation of ammonia, and the kinetics of bi-molecular reactions in solutions. Chief of research, Prof. Ya. K. Syrkin.

Electrical and optic properties of molecules and the problem of chemical bonds. Studies of the structure of chemical compounds ^{under} ~~by~~ ^{action of} ~~the~~ Raman effect. Use of ^{quantum} ~~quantum~~ chemistry methods for studying molecules. Chief of research, Prof. Ya. K. Syrkin.

Studies of the nature of chemical affinity. Studies of the properties of aluminum chloride. Chief of research, I. A. Kazarnovskiy.

Studies of the nature of ^{the} ~~chemical~~ bonds in complex compounds. Chief of research, B. F. Ormont.

^{Production} ~~Manufacture~~ of super-cooled ^{hard compounds} ~~solutions~~ by means of reactions in the gaseous phase. Chief of research, B. F. Ormont.

Studies of the physico-chemical properties of ^{liquefied} ~~burning~~ gases. Thermochemical research. Chief of research, Prof. A. M. Monoszon.

Studies of the mechanisms of reactions in ^{the} ~~dispersed~~ ^{state} ~~medium~~. Chief of research, G. A. Dmitriyev.

Studies of electrode processes in cases of simple and ^{combined deposition} ~~complex~~ ^{of} ~~isolation~~ of metals and ^{anode} ~~oxidation~~. Research on chromic ^{plating} ~~plating~~. Chief of research, D. V. Stepanov.

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Determination of standard, accelerated and simplified analysis methods.

Studies of surfaces for sound recording on gramophone disks by galvanic means. Manufacture of ^{body} forged parts for automobiles by galvanic methods.

Manufacture of a bi-metallic wire for an experimental communications line.

~~Production of compounds for the~~ ~~obtaining preparations for de-~~ greasing and pickling of metals. Chief of research, B. V. Stepanov.

Chemical methods for reinforcing soils around oil wells. Chemical reinforcement of loess. Chief of research, V. A. Kargin.

^{Production} ~~Manufacture~~ of potassium hypochloride by means of disperse drying.

^{dry} ~~Manufacture~~ drying of cellulose dyes. Chief of research, G. A. Dmitriyev.

Stabilization of potassium hypochloride under various conditions.

^{Findings} ~~Determination~~ of new catalysts for the synthesis of divinyl. Chief of research, M. Ya. Kaban.

Production of aluminium chloride in ^{on} experimental installations.

Determination of methods for the purification of aluminium chloride.

Extraction of selenium and lead acetate from chamber ^{chamber} ~~smoke~~. Chief of research Prof I. A. Kazarnovskiy.

Studies of the physico-chemical properties of photographic gelatines.

Work on the theory of photographic processes.

Work on the sensitivity and hyper-sensitivity of light-sensitive layers.

Chief of research, Prof A. I. Rabinovich.

ENTERPRISES REGULARLY SERVED BY THE INSTITUTE:

Automobile Plant imeni Molotov, Gorkiy

Chernorechensk Chemical Combine

Ugresh Chemical Combine, Moscow

Plants of the SK [Synthetic Rubber] Trust

Photo-cine Trust

Plants of Gramlast ~~Mass~~ [Gram ? Plastics Trust]

Moscow Meat Combine (Workshop of Toxic Admixtures, KS)

Plant No 2 "Sharikopodshipnik", [Ballbearing Plant], Moscow

"Bimetal" Trust

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~~ORGANIZATIONS~~
 FOREIGN ~~INSTITUTIONS~~ WITH WHICH Gosfizkhn MAINTAINS LIAISON:

Faraday Society, London

Bureau of International Photographic Congresses, Cambridge University,
 Cambridge.

Manchester University, Manchester

Laboratory of Colloid Chemistry, Utrecht, Holland.

TECHNICAL AND SCIENTIFIC BY Gosfizkhn TO INDUSTRY ON THE FOLLOWING MATTER:

Utilization of the phenomena of adsorption. Electro-chemical phenomena
 and the surface layer in metals. Electro-kinetic phenomena.

Surface voltage and methods for its measurement. Flotation - its theory
 and methods for studying it.

~~Technology at high vacuum~~

~~Technical aspects of super-vacuums.~~

Technical aspects of solid absorbers: activated carbon and silica gel.

Prevention of the icing and solidification of surfaces.

Electrochemistry of colloidal systems.

Problems of the coagulation and stabilization of colloids.

Determination of ~~the~~^{PH} by potentiometric methods using quinhydrone and glass
 electrodes.

Determination of the concentration of ions of chlorine, silver, potassium,
 sodium, barium and others, by potentiometric methods.

Problems of conductometric titration. Viscosimetry

Methods for studying and precipitation of smokes, fogs, and dust

Problems of the structure of matter. Dielectric properties of molecules.

Methods ~~for~~^{of} work on structural analysis. Theory and computation of
 electrochemical processes.

~~Determining the speed~~^{ation of velocities} of chemical reactions in solutions and in the gas-
 eous phase. Theoretical computations and experimental methods

Heterogeneous catalysis: theory and methodology of experiments. Problems
 of the kinetics of oxidation and mechanism of thermal decomposition of hydro-
 carbons.

Kinetics of the polymerization of butadiene

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the production of bleaching agents which contain chlorine. Methods for the packaging and drying of solutions and other materials in dispersions driers.

Production of alkali metals, particularly potassium, by means of thermal decomposition of cyanide and ferrocyanides.

Methods for the manufacture of photographic and cinematographic materials. Testing of photographic gelatins and emulsions as well as other materials used in photography.

LITERATURE PUBLISHED BY THE INSTITUTE:

"Trudy Instituta Imeni L. Ya. Karpova" Issues I to VIII (up to 1930)

"Trudy Fiziko-khimicheskikh Konferentsiy" Issues I to V (up to 1930)

"Zhurnal Fizicheskoy Khimii" (together with LKhF) from 1930

"Acta Physico-chemica USSR" (in foreign languages) since 1934

In 1918, on the initiative of L. Ya. Karpov, the Chemistry Division of VSNKh [Supreme Council of the National Economy] authorized the organization of a central chemical laboratory for scientific-technical aid to the growing chemical industry. At that time the staff of the laboratory consisted of 8 chemists and its physical installations were spread through several buildings. Out of these humble beginnings there was developed the Physico-Chemical Institute Imeni L. Ya. Karpov. During the early stages the Institute undertook chemical research in a number of diversified fields, and as a result was divided into various divisions, corresponding to the fields of chemical research. Many of the divisions in turn were split from the parent Institute and became institutes in their own right. After a relatively long organizational period, the Institute Imeni Karpov finally concentrated its scientific efforts on theoretical and applied problems in physical chemistry.

The Institute, at present (1935), undertakes research in three main fields:

- 1) studies of the structure of atoms and molecules;
- 2) studies of the structure of more complex ^{systems} ~~substances~~;
- 3) studies of the mechanism of chemical reactions.

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It must be noted, however, that physicists have been conducting most of the research with respect to the structure of matter. Nevertheless the chemical aspects of atoms and nuclei still ranks important in scientific research. In addition most of the ^{reactions and effects} ~~problems occurring~~ in the chemical industry, ^{occur} ~~have to do with matters~~ lying on the boundary between solids and gases or solids and solutions. Under Academician A. N. Frumkin it was possible to determine new methods for studying the surface layer in simple cases - the boundary between liquids and gases.

^{work in the field of electrochemistry} ~~Non-emphasis has always been placed on the study of the structure of matter~~ ~~thus leading~~ to the necessity of forming a group for the study of colloid chemistry. For this purpose a large Colloid Chemistry Division was ^{organized} ~~formed~~ and placed under the guidance of A. I. Izinovich. The main research trends of this Division involved studies of the electrochemistry of colloidal particles, problem of the stability of colloids, theory of coagulation, disintegration of colloidal particles, kinetics of their surfaces, and the kinetics and mechanisms of reactions between colloids. In recent years more and more emphasis has been placed on the study of the so-called lyophilic colloids.

This Division has had frequent occasion to coordinate its efforts with the Photo-Chemical Laboratory, particularly with respect to the study of photographic phenomena and optical sensitivity.

N. A. Fuks organized a special Laboratory for Aerosols as a result of the need for studying the nature of ^{the} ~~the~~ various colloidal particles ~~which~~ ^{suspended} ~~in~~ in the atmosphere and in various gas mixtures.

Special mention must be made of the studies conducted by A. M. Monoszon and his associates on the performance of solutions in ^{liquefied} ~~liquid~~ gases. In his laboratory, Monoszon was able, not only to establish a new method for working with these substances, but also to obtain ^{various} ~~special~~ results on the electro-chemistry of solutions in liquid ammonia, ^{liquid chlorine, and liquid sulfur dioxide which have} ~~and~~ great theoretical significance.

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In the Division of Inorganic Chemistry, I. A. Kazarnovskiy carried out some important work with respect to the solubility of gases in various solvents, in relation to their nature, pressure, the presence of dissolved salts, etc.

Research in the field of chemical kinetics was varied. Much attention was devoted to the study of the mechanisms of heterogeneous catalysis.

Personnel of the Division of Surface Phenomena determined ^{mechanisms} ~~conditions~~ ~~mechanisms of the contact~~ fixation of gas, thus presenting an easier method for studying the chemical properties of the gas in this intermediate state. Ya. K. Syrkin, in his laboratory, was able to ^{find} ~~determine~~ some very interesting results regarding the mechanisms of contact oxidation of ammonia.

S. S. Medvedev supervised a group at his laboratory in research on the mechanisms of conversion of hydrocarbons ^{into} ~~during~~ such reactions as oxidation, thermal and catalytic decomposition reactions, and polymerization. Results of these research projects have had wide application in the petroleum industry, particularly with respect to the cracking of petroleum and the utilization of natural and ^{by-product} ~~cracked~~ gas.

Many interesting and valuable results were also obtained by A. N. Bakh in his laboratory. Studies were aimed at explaining the nature of biological catalysis and the oxidation-reduction processes which are closely allied to this phenomenon. The development of a micro-method for determining the ^{enzyme} ~~biological catalyst-ferments~~ permitted observation of changes in ^{enzyme} ~~fermentation~~ ~~constants~~ ~~indicators~~ within seeds. This method was applied by Prof. A. I. Smirnov, ^{enzymes of} ~~fermentation in~~ Institute of Tobacco Studies at Krasnodar for the study of ~~fermentation in~~ tobacco and permitted him to explain the non-seasonal fermentation of tobacco. A. N. Bakh, with the aid of Z. V. Yermoleyeva of the Biochemical Institute [Academy of Sciences, USSR] was able to isolate from azotobacter, which did not contain live cells, a sap, which would combine with nitrogen at ordinary temperatures and pressures as a result of the simultaneously occurring oxidation reaction.

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The Institute, in setting up its research programs, has already stressed the necessity for close liaison with other scientific research institutes carrying out physico-chemical research. At any time one will find personnel of other physico-chemical research institutes of the USSR conducting studies and utilizing the facilities of the Physico-Chemistry Institute Iseri Karpov. The periodical "Zhurnal Fizicheskoy Khimii" which was initiated by the Institute and the Leningrad Physico-Chemistry Group publishes the research of all Soviet physico-chemists. Recently a periodical "Acta Physico-chemica" with the same purpose has been started, but printed in foreign languages, so as to permit scientists outside of the borders of the USSR to appreciate the achievements of Soviet scientists.

The Institute carries out much research work in addition to that which was stated above. However all its work bears a single purpose - to free Soviet industry from reliance on foreign technological achievements.

Some significant progress has already been made in the program for complete severance from foreign dependence. The Institute, on its own, was able to develop a special shatter proof glass "tripleks" for use in aircraft. The recommended production methods were tried on semi-industrial installations at the "Avtosteklo" Plant in Konstantinovka. Initial results were so successful, that the following year a special plant for the manufacture of "tripleks" was constructed at Konstantinovka. The major triumph consisted of the fact that all the equipment at this plant was of domestic manufacture.

I. A. Kazarnovskiy, at the Division of Inorganic Chemistry was able to develop a new method for the processing of clays ^{for the production of aluminium} utilizing a combined method which involves ^{the manufacture of} aluminium chloride and aluminium oxide ^{for use in the petroleum industry} as catalysts. Basically ^{then} the method involves the processing of clays for the production of aluminium chloride. This chloride ^{is then converted into pure} acts as a catalyst in cracking operations. The residue is ^{then heated with} aluminium oxide, ^{used for} ~~as a catalyst~~ in the manufacture of the pure aluminium metal. It is planned to construct a experimental aluminium chloride plant within the organizational

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competence of Ugrech Chemical Combine and also to initiate the construction of plants for cracking with aluminium chloride for the production of synthetic lubricants. These latter plants will be started at Groznyy during the middle part of 1935.

Some interesting results have been obtained by G. A. Dmitriyev at the Laboratory of Reactions in ^{The} ~~Dispersed~~ ^{State} ~~Unagitated~~, with respect to perfecting a method of dispersed drying. Special model drying equipment has been designed by G. A. Dmitriyev, and has been built by "Giproddim", ^{State} ~~Planning~~ ^{Institute for Chemical Industries} under the supervision of Engineer S. V. Govikov. Great importance can also be attached to work done by S. S. Medvedev at the Laboratory of Organic Catalysis. After three years of intensive research, he, along with his group of workers, was able to develop a new method for the chemical conversion of methane into formaldehyde. This development is particularly significant in view of the fact that at that time [1935], the USSR, was entirely dependent upon foreign imports for her supply of formalin. Requirement for formalin at the end of the second five year plan were in the vicinity of 28,000 tons. Of this amount about 6000 tons can be supplied by processing methanol, while 22,000 tons will have to be manufactured by the ~~Institute-developed~~ ^{developed at the Institute} method. All the basic research for this new method of manufacturing formaldehyde has been completed. At the present time plans are underway to construct several new plants in the vicinity of the Surukhan oil fields, to put this new method into practice.

In 1935 the USSR also experienced a critical shortage of organic solvents. The Soviet chemical industry as early as 1929 asked a foreign firm for assistance in setting up an installation for the manufacture of acetic acid. However, it finally fell upon the Institute, and M. Ya. Kagan, to develop a new method for the manufacture of organic solvents. He established a method for contact oxidation of ethyl alcohol for the manufacture of several synthetic solvents, such as acetone, ethyl ether and acetaldehyde. Excellent results

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obtained in the manufacture of acetic acid - as a result ~~of~~ research conducted in the USSR will be the basis for the construction, in the near future, of a large plant for the manufacture of this substance. Plans are also underway to provide for the manufacture of ethylacetate at all "SK" ~~[Synthetic rubber]~~ plants.

D. V. Stepanov has done considerable research at the Division of ~~Engineering~~ ^{Technical} Electrochemistry on the nature of various types of platings and the manner in which various platings will protect other metals from corrosion. As a result of research on various methods of electroplating, plans are being approved for the construction of several large electroplating shops and plants. Shops will be organized at the Beloroslak and Zaporozh'ye plants (during the first part of 1935) and a wire plant will be constructed at Levdivinsk and a sheet steel plant will be constructed at Rytyvenskiy. The Laboratory of ~~Engineering~~ ^{Technical} Electrochemistry, in addition to studying the anti-corrosion effects of various platings has studied methods for economizing, where critical materials are concerned, and has also developed methods for the restoration of equipment by plating the worn parts of machines and tools. Such research has gone into the control of pickling operations. In 1928, Soviet scientists were able to develop a special pickling agent "Antra", which is not being manufactured at the present time due to shortage of raw materials. After that a substitute was developed and named "Regulator of Pickling KS". It is manufactured from slaughter-house wastes. By a later decree of the People's Commissariat for Heavy Industries, this substance - "KS" - was recommended for use by all enterprises in the metals industry.

The Physico-Chemistry Institute imeni Karpov also did considerable research with respect to chemical methods for reinforcing soils. In the Division of Colloid Chemistry, V. A. Kargin and his group studied methods for applying chemical methods for hardening soils in regions where wells were about to be drilled. The same basic principles were also applied to strengthening soils for purposes of rapid road building, and the construction of foundations

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for buildings. A similar method was used in Germany, but was considered a secret process. Engineer V. A. Rannitsyn then started to work on the "Secret" at the Institute of Water Supply and Hydrogeology, (VODGEO) with the assistance of the Institute Imeni Karpov. The first field attempts were conducted in 1932 with excellent results.

The Physico-Chemistry Institute Imeni L. Ya. Karpov, has always striven to maintain close liaison with industry. Thus the Division of Analytical Chemistry has always aided laboratories and institutes of the USSR with their special problems. The Institute also played an important part in the organization of the various laboratories at the Chernorechenok Chemical Combine. Irrefutable proof of the constant liaison maintained by the Institute is the existence, within its walls, of a Colloid Laboratory, supervised by A. I. Labinovich, and which in reality belongs within the organizational structure of the Photo-Cine Institute. The present existence of laboratories at the Berezniki, Stalinogorsk, Gresh, Glikansk, Aktyubinsk, Kalatinsk and Glavoda chemical combines is due to the assistance rendered by the Institute Imeni Karpov.

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